Arsenic residue in blood, urine and faeces samples from cattle in the Nadia district of West Bengal in India

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Citation

T Rana, S Sarkar, T Mandal, K Bhattyacharyya, A Roy. *Arsenic residue in blood, urine and faeces samples from cattle in the Nadia district of West Bengal in India*. The Internet Journal of Veterinary Medicine. 2007 Volume 4 Number 1.

Abstract

A total number of thirty clinical cases suspected to be suffering from arsenic toxicity were selected for the present study at Arsenic affected zone in Nadia district of West Bengal in India. The mean arsenic concentrations in blood, urine and faeces of arsenic affected cattle (categorized as Gr.II) were 0.284 ppm, 0.286 ppm and 0.643 ppm respectively. The mean arsenic concentration in blood, urine and faeces of control cattle (categorized as Gr.I) were 0.054 ppm., 0.067 ppm and 0.128 ppm. respectively. The mean values of arsenic in blood, urine and faeces in Gr.II was significantly higher ($P < 0.01$) than the control cattle (Gr. I).

INTRODUCTION

Arsenic that comes from the surface due to agricultural irrigation and withdrawing underground water, geothermal power plants, mining industrial effluents has seriously contaminated the environment. Arsenic has a sweet taste and is not an irritant to the throat, and it has characteristic that have led to its popularity as a poison (Wilson et al. , 1977). Ground water is one of the most important sources of drinking water and the contamination of ground water with arsenic is one of the serious problems encountered in India. Soil contamination with arsenic occurs through the vehicle contaminated groundwater being used for irrigation. Arsenic contamination of plants occurs by irrigation with contaminated ground water. The groundwater in West Bengal contaminates surface soils and plants thereby arsenic enters the food chain. It is expected that arsenic is distributed through the food web chain throughout the animal kingdom. Experience with field case of arsenic poisoning indicates that animals which were weak, debilitated, dehydrated are more susceptible to arsenic poison.

Due to intake of plants arsenic is liberated in the rumen and causes ruminal stasis and further accumulation of significant amount of arsenic within the rumen. The rapid absorption (acute case) and slow absorption (chronic case) of arsenic within the rumen causes ruminal impaction, diarrhoea, dehydration, anorexia, progressive weight loss, anaemia and in acute case sudden death occurs. the present study was undertaken to evaluate the arsenic concentration in blood, urine and faeces in cattle at arsenic affected zone in Nadia district of West Bengal in India.

MATERIALS AND METHODS

CRITERIA FOR SELECTION OF CLINICAL CASES AND EXPERIMENTAL DESIGN

A total number of thirty clinical cases suspected to be suffering from arsenic toxicity with the clinical signs including depression, prostration, weight loss, weakness, dehydration, anaemia, anorexia, diarrhoea with blood, ruminal stasis, lethargy, dermatosis, reddish urine, dry dull rough, epilated hair coat, anoestrus were screened by haemato-biochemical examinations. They were selected for inclusion in the present study based on the significant alterations suggesting of arsenic toxicity. These ten healthy animals were kept as a healthy control group (Gr. I) & the thirty clinical cases of each species which were randomly selected for this study were kept as experimental group (Gr.II).

All the animals of different groups were subjected to the following experimental procedure as given below:

Figure 1

Group (Gr.)	No. of Animals	Types of cases.
Gr. I	10	Healthy control cattle.
Gr. II	30	Clinical cases of arsenic toxicity in cattle.

During the survey period, routine clinical examinations like haematological and blood and serum biochemical examinations were done.

ESTIMATION OF ARSENIC IN BLOOD

Arsenic content in blood of control and experimental animals was estimated as per AAS method described by Sandal (1950) Arneza et al. (1977) & Sarkar (1989).

A known volume of serum was digested with double the volume of triple acids[Nitric acid 10 parts, Perchloric acid 3 parts & Sulphuric acid 1 part (V/v)] on hot plate & dilution to a known concentration was finally made with de-ionised water by filtration (Whatman filter paper No.42).

STATUS OF ARSENIC IN BLOOD:

The above aliquot was used for the estimation of arsenic in the blood in AAS and values were expressed in terms of µg/ml or ppm

STATUS OF ARSENIC IN URINE AND FAECES OF ANIMALS

COLLECTION OF URINE AND FAECES FROM ANIMALS

50 ml of urine samples of animals were collected in prewashed and dried plastic bottles. Immediately after collection, concentrated hydrochloric acid (1 ml in 100 ml urine) was added to prevent bacterial growth. Collected samples were stored at -20º C temperature until analysed.

The faecal samples were collected (10 gm) in polythene zipper bag and stored at -20º C until further analysis (Sarder, 2004).

ESTIMATION OF ARSENIC IN URINE AND FAECES

Urine and faecal samples (1 gm or ml) were digested with 10 ml of tri-acid mixture of nitric acid (HNO_3), sulphuric acid (H_2SO_4) and perchloric acid ($HClO_4$) at the ratio of 6:4:1(v/v) after properly weighing in electronic weighing balance and the samples were placed on heating platform at the temperature of less than 150ºC until watery colour of the solution appeared. After the samples completely digested were cooled and the clear mixture was transferred to a 10 ml of volumetric flask and the volume was made upto mark with triple distilled deionised water. The solution was then filtered through Whatman filter paper (No. 1) and the filtrate was used for arsenic estimation within few hours (Sarder, 2004).

STATUS OF ARSENIC IN URINE AND FAECES

The above aliquots were used for the estimation of arsenic in the urine and faeces in AAS and values were expressed in terms of µg/ml or ppm (for urine) and ?g/gm or ppm (for faeces).

CRITERIA FOR ANALYSIS OF BLOOD, URINE AND FAECES OF ANIMALS

Blood, urine and faecal samples were analysed for estimation of arsenic. They were as follows.

Figure 2

Samples name	Total number of samples	Types of cases.
Blood	30	Blood samples were collected from jugular vein of clinically affected animals.
Urine	30	Urine samples were collected from cattle in arsenic affected zone.
Faeces	30	Faecal samples were collected from clinically affected animals.

All the data obtained were analysed in SPSS (version 10.0) following general linear model. The results were expressed as mean and pulled SE of mean (SEM).Healthy groups were considered as fixed factors and different blood and biochemical parameters were considered as dependant variable. The means were compared using Independent t tests. Probability of $P < 0.01$ and $P<0.05$ were described as highly significant (at 1% level) and significant (at 5% level) respectively.

RESULTS AND DISCUSSION

STATUS OF ARSENIC IN BLOOD OF ANIMALS

The recovery percentage of As in blood was found to be in the range of 82.8 to 86.3%. Therefore this experimental procedure as stated above for estimation of arsenic was accepted.

The As concentration in blood (table 1.) of Gr. II (0.284 ± 0.014 ppm) was significantly higher than that of animals of Gr. I (0.054 ± 0.044ppm).

Significant increase level of As was possibly due to intake of plants containing high amount of As.

Selby et al. (1974) opined that the toxic dose of arsenic is as low as 0.75mg/kg in blood.

The findings was simulated with the reports of Rosiles (1977), Biswas et al. (1998) and Fieldman et al. (2000) who recorded the increased level of As in As toxicated animals.

Information in connection with this profile in the literature collected for the present study was scanty.

STATUS OF ARSENIC IN URINE, FAECES OF

ANIMALS

From the table 1 statistical analysis($P<0.01$) showed that the arsenic concentration in urine of Gr.II (0.286 ± 0.014ppm) was significantly higher than the control animal (0.067± 0.030 ppm).

Increased level of As in urine might be due to higher concentration of As in blood.

This finding was corroborated with the report of Lakso et al. (1975) who recorded that the permissible limit of inorganic arsenic in urine sample of cattle was 0.05-0.17 mg/L(methyl arsenate-0.12-0.26 mg/L).

The report of present study was in accordance with the report of Browning (1969) as urinary excretion of As rises with the increasing Ac intake so that he total urinary Ac excretion provides a useful index of exposure.

The observation was simulated with the report of Wagner and Weswig (1975) and Underwood (1977).

From the table 1, the statistical analysis showed that the concentration of As (0.643 ± 0.015ppm) in faeces of Gr.II was increased significantly ($P<0.01$) than that of the healthy control group (0.128 ± 0.056 ppm).

The concentration of As in faeces is higher than the concentration of As in urine.

Increased level of As in faeces confirmed the findings of As content in blood & urine.

Figure 3

Table 1: Mean ± S.E. of the values of arsenic level in blood, urine and faeces of Control (Gr. I) and affected (Gr. II) animals.

Arsenic concentrations	Groups	Mean	SEM	Significance level(P Value)
arsenic in blood (µg/ml) or ppm [n=30]	Gr.I	0.054^a	0.044	0.000
	Gr. II	0.284^b	0.014	
arsenic in urine (µg/ml) or ppm [n=30]	Gr.I	0.067^a	0.030	0.000
	Gr. II	0.286^b	0.014	
arsenic in faeces (µg/gm) or ppm [n=30]	Gr.I	0.128^a	0.056	0.000
	Gr.II	0.643^b	0.015	

Superscript (a, b) denotes there is significance difference exist between two mean.

Significant value ($P<0.01$) indicates highly significant at 1% level.

Significant value ($P<0.05$) indicates significant at 5% level.

ACKNOWLEDGEMENT

The authors are thankful to the Dean of the faculty for providing the necessary facilities to conduct the research work.

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